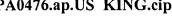# DEVICE AND METHOD FOR CONTINUOUSLY SHUFFLING AND MONITORING CARDS

RELATED APPLICATIONS

~~This application is a continuation-in-part of U.S. Patent Application Serial No. 09/000,598, filed 15 April 1998 and Titled "DEVICE AND METHOD FOR CONTINUOUSLY~~ SHUFFLING CARDS,"

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to devices for handling cards, including cards known as "playing cards." In particular, it relates to an electromechanical machine for continuously shuffling playing cards, whereby a dealer has a substantially continuously readily available supply of shuffled cards for dealing and where cards may be monitored for security purposes during play of the game.

2. Background of the Art

Wagering games based on the outcome of randomly generated or selected symbols are well known. Such games are widely played in gaming establishments and include card games wherein the symbols comprise familiar, common or standard playing cards. Card games such as twenty-one or blackjack, poker, poker variations, match card games and the like are excellent casino card games. Desirable attributes of casino card games are that they are exciting, that they can be learned and understood easily by players, and that they move or are played rapidly to their wager-resolving outcome.

From the perspective of players, the time the dealer must spend in shuffling diminishes the excitement of the game. From the perspective of casinos, shuffling time reduces the number of wagers placed and resolved in a given amount of time, thereby reducing revenue. Casinos

would like to maximize the amount of revenue generated by a game without changing games, without making obvious changes that indicate an increased hold by the house, particularly in a popular game, and without increasing the minimum size of wagers. One approach to maximizing revenue is speeding play. It is widely known that playing time is diminished by shuffling and dealing. This approach has lead to the development of electromechanical or mechanical card shuffling devices. Such devices increase the speed of shuffling and dealing, reduce non-play time, thereby increasing the proportion of playing time to non-playing time, adding to the excitement of a game by reducing the time the dealer or house has to spend in preparing to play the game.

U.S. Patent 4,515,367 (Howard) is an example of a batch-type shuffler. The Howard patent discloses a card mixer for randomly interleaving cards including a carriage supported ejector for ejecting a group of cards (approximately two playing decks in number) which may then be removed manually from the shuffler or dropped automatically into a chute for delivery to a typical dealing shoe.

U.S. Patent 5,275,411(Breeding) discloses a machine for automatically shuffling a single deck of cards including a deck receiving zone, a carriage section for separating a deck into two deck portions, a sloped mechanism positioned between adjacent corners of the deck portions, and an apparatus for snapping the cards over the sloped mechanism to interleave the cards.

~~U.S. Patent 3,870,054 (Erickson et al.) discloses the concept of delivering cards one at a~~ time, into one of a number vertically stacked card shuffling compartments. The Erickson patent also discloses using a logic circuit to determine the sequence for determining the delivery location of a card, and that a card shuffler can be used to deal stacks of shuffled cards to a player. U.S. Patent 5,241,140 (Huen) discloses a card dispenser which dispenses or deals cards in four discrete directions onto a playing surface, and U.S. Patents 793,489 (Williams), 2,001,918 (Nevius), 2,043,343 (Warner) and 3,312,473 (Friedman et al.) disclose various card holders some of which include recesses (e.g., Friedman et al.) to facilitate removal of cards. U.S. Patents 2,950,005 (MacDonald) and 3,690,670 (Cassady et al.) disclose card sorting devices which ~~require specially marked cards, clearly undesirable for gaming and casino play.~~

U.S. Patents 5,584,483 and 5,676,372 (Sines et al.) describe batch type shufflers which include a holder for an unshuffled stack of cards, a container for receiving shuffled cards, a

plurality of channels to guide the cards from the unshuffled stack into the container for receiving shuffled cards, and an ejector mounted adjacent to the unshuffled stack for reciprocating movement along the unshuffled stack. The position of the ejector is randomly selected. The ejector propels a plurality of cards simultaneously from a number of points along the unshuffled stack, through the channels, and into the container. A shuffled stack of cards is made available to the dealer.

U.S. Patent 5,695,189 (Breeding et al.) is directed to a shuffling machine for shuffling multiple decks of cards with three magazines wherein unshuffled cards are cut then shuffled.

Aside from increasing speed and playing time, some shuffler designs have provided added protection to casinos. For example, one of the Breeding (similar to that described in U.S. Patent 5,275,411) shufflers is capable of verifying that the total number of cards in the deck has not changed. If the wrong number of cards are counted, the dealer can call a misdeal and return bets to players.

A number of shufflers have been developed which provide a continuous supply of shuffled cards to a player. This is in contrast to batch type shuffler designs of the type described above. The continuous shuffling feature not only speeds the game, but protects casinos against players who may achieve higher than normal winnings by counting cards or attempting to detect repeated patterns in cards from deficiencies of randomization in single batch shufflers. An example of a card game in which a card counter may significantly increase the odds of winning by card counting or detecting previously occurring patterns or collections of cards is Blackjack.

U.S. Patent 4,586,712 (Lorber et al.) discloses a continuous automatic shuffling apparatus designed to intermix multiple decks of cards under the programmed control of a computer. The Lorber et al. apparatus is a carousel-type shuffler having a container, a storage device for storing shuffled playing cards, a removing device and an inserting device for intermixing the playing cards in the container, a dealing shoe and supplying means for supplying the shuffled playing cards from the storage device to the dealing shoe. The Lorber shuffler counts the number of cards in the storage device prior to assigning cards to be fed to a particular location.

The Samsel, Jr. patent (U.S. Patent 4,513,969) discloses a card shuffler having a housing with two wells for receiving stacks of cards. A first extractor selects, removes and intermixes the bottommost card from each stack and delivers the intermixed cards to a storage compartment. A

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second extractor sequentially removes the bottommost card from the storage compartment and delivers it to a typical shoe from which the dealer may take it for presentation to the players.

U.S. Patent 5,382,024 (Blaha) discloses a continuous shuffler having a unshuffled card receiver and a shuffled card receiver adjacent to and mounted for relative motion with respect to the unshuffled card receiver. Cards are driven from the unshuffled card receiver and are driven into the shuffled card receiver forming a continuous supply of shuffled cards. However, the Blaha shuffler requires specially adapted cards, particularly, plastic cards, and many casinos have demonstrated a reluctance to use such cards.

U.S. Patent 5,000,453 (Stevens et al.) discloses an apparatus for automatically and continuously shuffling cards. The Stevens et al. machine includes three contiguous magazines with an elevatable platform in the center magazine only. Unshuffled cards are placed in the center magazine and the spitting rollers at the top of the magazine spit the cards randomly to the left and right magazines in a simultaneous cutting and shuffling step. The cards are moved back into the center magazine by direct lateral movement of each shuffled stack, placing one stack on top of the other to stack all cards in a shuffled stack in the center magazine. The order of the cards in each stack does not change in moving from the right and left magazines into the center magazine.

U.S. Patent 4,770,421 (Hoffman) discloses a continuous card-shuffling device including a card loading station with a conveyor belt. The belt moves the lowermost card in a stack onto a distribution elevator whereby a stack of cards is accumulated on the distribution elevator. Adjacent to the elevator is a vertical stack of mixing pockets. A microprocessor preprogrammed with a fixed number of distribution schedules is provided for distributing cards into a number of pockets. The microprocessor sends a sequence of signals to the elevator corresponding to heights called out in the schedule. Single cards are moved into the respective pocket at that height. The distribution schedule is either randomly selected or schedules are executed in sequence. When the cards have been through a single distribution cycle, the cards are removed a stack at a time and loaded into a second elevator. The second elevator delivers cards to an output reservoir. Thus, the Hoffman patent requires a two step shuffle, i.e., a program is required to select the order in which stacks are moved onto the second elevator. The Hoffman patent does not disclose randomly selecting a pocket for delivering each card. Nor does the patent disclose a

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single stage process which randomly arranges cards into a degree of randomness satisfactory to casinos and players. Although the Hoffman shuffler was commercialized, it never achieved a high degree of acceptance in the industry. Card counters could successfully count cards shuffled in the device, and it was determined that the shuffling of the cards was not sufficiently random.

5   U.S. Patent 5,683,085 (Johnson) describes a continuous shuffler which includes a chamber for supporting a main stack of cards, a loading station for holding a secondary stack of cards, a stack gripping separating mechanism for separating or cutting cards in the main stack to create a space and a mechanism for moving cards from the secondary stack into the spaces created in the main stack.

10   U.S. Patent 4,659,082 (Greenberg) discloses a carousel type card dispenser including a rotary carousel with a plurality of card compartments around its periphery. Cards are injected into the compartments from an input hopper and ejected from the carousel into an output hopper. The rotation of the carousel is produced by a stepper motor with each step being equivalent to a compartment. In use, the carousel is rotated past n slots before stopping at the slot from which a card is to be ejected. The number n is determined in a random or near random fashion by a logic circuit. There are 216 compartments to provide for four decks and eight empty compartments when all the cards are inserted into compartments. An arrangement of card edge grasping drive wheels are used to load and unload the compartments.

U.S. Patent 5,356,145 (Verschoor) discloses another card shuffler involving a carousel or "rotatable plateau." The Verschoor shuffler has a feed compartment and two card shuffling compartments which each can be placed in first and second positions by virtue of a rotatable plateau on which the shuffling compartments are mounted. In use, once the two compartments are filled, a drive roller above one of the shuffling compartments is actuated to feed cards to the other compartment or to a discharge means. An algorithm determines which card is supplied to the other compartment and which is fed to the discharge. The shuffler is continuous in the sense that each time a card is fed to the discharge means, another card is moved from the feed compartment to one of the shuffling compartments.

U.S. Patent 4,969,648 (Hollinger et al.) discloses an automatic card shuffler of the type that randomly extracts cards from two or more storage wells. The shuffler relies on a system of solenoids, wheels and belts to move cards. Cards are selected from one of the two wells on a

random basis so a deck of intermixed cards from the two wells is provided in a reservoir for the dealer. The patent is principally directed to a method and apparatus for detecting malfunctions in the shuffler, which at least tends to indicate that the Hollinger et al. shuffler may have some inherent deficiencies, such as misalignments of extraction mechanisms.

5   The size of the buffer supply of shuffled cards in the known continuous shufflers is large, i.e., 40 or more cards in the case of the Blaha shuffler. The cards in the buffer cannot include cards returned to the shuffler from the previous hand. This undesirably gives the player some information about the next round.

Randomness is determined in part by the recurrance rate of a card previously played in

10   the next consecutively dealt hand. The theoretical recurrence rate for known continuous shufflers is believed to be about zero percent. A completely random shuffle would yield a 13.5% recurrance rate using four decks of cards.

Although the devices disclosed in the preceding patents, particularly the Breeding machines, provide improvements in card shuffling devices, none describes a device and method

15   for providing a continuous supply of shuffled cards with the degree of randomness and reliability required by casinos until the filing of copending U.S. Patent Application Serial No. 09/060,598. That device and method continuously shuffles and delivers cards with an improved recurrence rate and improves the acceptance of card shufflers and facilitate the casino play of card games.

BRIEF SUMMARY OF THE INVENTION

20   The present invention provides an electromechanical card handling apparatus and method for continuously shuffling cards. The apparatus and, thus, the card handling method or process, is controlled by a programmable microprocessor and may be monitored by a plurality of sensors and limit switches. While the card handling apparatus and method of the present invention is well suited for use in the gaming environment, particularly in casinos, the apparatus and method

25   may find use in handling or sorting sheet material generally.

In one embodiment, the present invention provides an apparatus for moving playing cards from a first group of unshuffled cards into shuffled groups of cards. The apparatus comprises a card receiver for receiving the first group of cards, a single stack of card-receiving compartments generally adjacent to the card receiver, the stack generally vertically movable, an elevator for

30   raising and lowering the stack, a card-moving mechanism between the card receiver and the

stack for moving cards, one at a time, from the card receiver to a selected compartment, and a microprocessor that controls the card-moving mechanism and the elevator so that the cards are moved into a number of randomly selected compartments. Sensors act to monitor and to trigger operation of the apparatus, card moving mechanisms, and the elevator and also provide

5 information to the microprocessor. The controlling microprocessor, including software, selects or identifies where cards will go as to the selected slot or compartment before card handling operations begin. For example, a card designated as card 1 may be directed to slot 5, a card designated as card 2 may be directed to slot 7, a card designated as card 3 may be directed to slot 3, etc.

10 An advantage of the present invention is that it provides a programmable card-handling machine with a display and appropriate inputs for controlling and adjusting the machine. Additionally, there may be an elevator speed adjustment and sensor to adjust and monitor the position of the elevator as cards wear or become bowed or warped. These features also provide for interchangeability of the apparatus, meaning the same apparatus can be used for many

15 different games and in different locations thereby reducing or eliminating the number of back up machines or units required at a casino. Since it is customary in the industry to provide free backup machines, a reduction in the number of backup machines needed presents a significant cost savings. The display may include a use rate and/or card count monitor and display for determining or monitoring the usage of the machine.

20 Another advantage of the present invention is that it provides an electromechanical playing card handling apparatus for automatically and randomly generating a continuous supply of shuffled playing cards for dealing. Other advantages are a reduction of dealer shuffling time, and a reduction or elimination of security problems such as card counting, possible dealer manipulation and card tracking, thereby increasing the integrity of a game and enhancing casino

25 security.

Yet another advantage of the card handling apparatus of the present invention is that it converts a single deck, multiple decks, any number of unshuffled cards or large or small groups of discarded or played cards into shuffled cards ready for use or reuse in playing a game. To accomplish this, the apparatus includes a number of stacked or vertically oriented card receiving

30 compartments one above another into which cards are inserted, one at a time, so a random group

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of cards is formed in each compartment and until all the cards loaded into the apparatus are distributed to a compartment. Upon demand, either from the dealer or a card present sensor, or automatically, the apparatus delivers one or more groups of cards from the compartments into a dealing shoe for distribution to players by the dealer.

The present invention may include jammed card detection and recovery features, and may include recovery procedures operated and controlled by the microprocessor.

Another advantage is that the apparatus of the present invention provides for the initial top feeding or loading of an unshuffled or discarded group of cards thereby facilitating use by the dealer. The shuffled card receiving shoe portion is adapted to facilitate use by a dealer.

An additional advantage of the card handling apparatus of the present invention is that it facilitates and speeds the play of casino wagering games, particularly those games wherein multiple decks of cards are used in popular, rapidly played games (such as twenty-one or blackjack), making the games more exciting for players.

In use, the apparatus of the present invention is operated to process playing cards from an initial, unshuffled new or played group of cards into a group of shuffled or reshuffled cards available to a dealer for distribution to players. The first step of this process is the dealer placing an initial group of cards, comprising unshuffled or played cards, into the card receiver of the apparatus. The apparatus is started or starts automatically by sensing the presence of the cards and, under the control of the integral microprocessor, it transfers the initial group of cards, randomly, one at a time, into a plurality of compartments. Groups of cards in one or more compartments are delivered, upon the dealer's demand or automatically, by the apparatus from that compartment to a card receiving shoe for the dealer to distribute to a player.

According to the present invention, the operation of the apparatus is continuous. That is, once the apparatus is turned on, any group of cards loaded into the card receiver will be entirely processed into one or more groups of random cards in the compartments. The software assigns an identity to each card and then directs each identified card to a randomly selected compartment by operating the elevator motor to position that randomly selected compartment to receive the card. The cards are unloaded in groups from the compartments, a compartment at a time, as the need for cards is sensed by the apparatus. Thus, instead of stopping play to shuffle or reshuffle cards, a dealer always has shuffled cards available for distribution to players.

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The apparatus of the present invention is compact, easy to set up and program and, once programmed, can be maintained effectively and efficiently by minimally trained personnel who cannot affect the randomness of the card delivery. This means that the machines are more reliable in the field. Service costs are reduced, as are assembly and set up costs.

5   Another concern in continuous shufflers is the fact that there has been no ability to provide strong security evaluation in the continuous shufflers, because of the very fact that the cards are continuously being reshuffled, with cards present within and outside the shuffler. This offers an increased risk of cards being added to the deck by players or being removed and held back by the player. This is a particular concern in games where the player is allowed to contact

10   or pick up cards during play (e.g., in certain poker-type games and certain formats for blackjack). The present invention provides a particular system wherein the total number of cards in play at the table may be counted with minimum game interruption.

The system of the present invention, in addition to allowing a security check on the number of cards present in the collection of decks, allows additional cards, such as promotional

15   cards or bonus cards, to be added to the regular playing cards, the total number of cards allowable in play modified to the number of regular playing cards plus additional (e.g., special) playing cards, allowing the shuffler to be modified for a special deck or deck(s) where there are fewer than normal cards (e.g., Spanish 21® blackjack game), or otherwise modified at the direction of the house. Therefore, the shuffler would not be limited to counting security for only

20   direct multiples of conventional 52 card playing decks. The shuffler may be provided with specific selection features wherein a game may be identified to the microprocessor and the appropriate number of cards for that game shall become the default security count for the game selected.

The present invention also describes a structural improvement in the output shoe cover to

25   prevent cards that are already within the shoe from interfering with the delivery of additional cards to the shoe.

A novel gravity feed/diverter system is described to reduce the potential for jamming and reducing the chance for multiple cards to be fed from a card feeder into selected card receiving compartments.

Other features and advantages of the present invention will become more fully apparent and understood with reference to the following specification and to the appended drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

5   Figure 1 is a front perspective view depicting the apparatus of the present invention as it might be disposed ready for use in a casino on a gaming table.

Figure 2 is a perspective view, partially broken away, depicting the rear of the apparatus of the present invention.

Figure 3 is a front perspective view of the card handling apparatus of the present

10   invention with portions of the exterior shroud removed.

Figure 4 is a side elevation view of the present invention with the shroud and other portions of the apparatus removed to show internal components.

Figure 5 is a side elevation view, largely representational, of the transport mechanism and rack assembly of the apparatus of the present invention.

15   Figure 5a is an expanded side elevation view of a shelf as shown in Figure 5, showing more detail of the rack assembly, particularly the shelves forming the top and bottom of the compartments of the rack assembly.

Figure 6 is an exploded assembly view of the transport mechanism shown in Figure 5.

Figure 7 is a top plan view, partially in section, of the transport mechanism.

20   Figure 8 is a top plan view of one embodiment of the pusher assembly of the present invention.

Figure 8a is a perspective view of a pusher assembly of the present invention.

Figure 9 is a front elevation view of the rack and elevator assembly.

Figure 10 is an exploded assembly view of one embodiment of a portion of the rack and

25   elevator assembly.

Figure 11 depicts an alternative embodiment of the shelves or partitions for forming the stack of compartments of the present invention.

Figure 12 is a simplified side elevation view, largely representational, of the card handler of the present invention.

Figure 13 is a perspective view of a portion of the card handling apparatus of the present invention, namely, the second card receiver at the front of the apparatus, with a cover portion of the shroud removed.

Figure 14 is a schematic diagram of an electrical control system for one embodiment of the present invention.

Figure 15 is a schematic diagram of the electrical control system.

Figure 16 is a schematic diagram of an electrical control system with an optically-isolated bus.

Figure 17 is a detailed schematic diagram of a portion of Figure 16.

Figure 18 is a side elevational view of a device that prevents the dealer from pushing cards in the output shoe back into the card way.

Figure 19 a side view of a new feeder system with a novel design for a card separator that has the potential for reducing jamming and reducing the potential for multiple card feed when a single card is to be fed.

DETAILED DESCRIPTION

This detailed description is intended to be read and understood in conjunction with appended Appendices A and B, which are incorporated herein by reference. Appendix A provides an identification key correlating the description and abbreviation of certain motors, switches and photoeyes or sensors with reference character identifications of the same components in the Figures, and gives the manufacturers, addresses and model designations of certain components (motors, limit switches and sensors). Appendix B outlines steps in a homing sequence, part of one embodiment of the sequence of operations.

With regard to means for fastening, mounting, attaching or connecting the components of the present invention to form the apparatus as a whole, unless specifically described as otherwise, such means are intended to encompass conventional fasteners such as machine screws, rivets, nuts and bolts, toggles, pins and the like. Other fastening or attachment means appropriate for connecting components include adhesives, welding and soldering, the latter particularly with regard to the electrical system of the apparatus.

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All components of the electrical system and wiring harness of the present invention are conventional, commercially available components unless otherwise indicated, including electrical components and circuitry, wires, fuses, soldered connections, chips, boards and control system components.

5   Generally, unless specifically otherwise disclosed or taught, the materials for making the various components of the present invention are selected from appropriate materials such as metal, metallic alloys, ceramics, plastics, fiberglass and the like, and components and materials may be similar to or adapted from components and material used to make the card handling apparatus disclosed and described in copending application Serial No. 09/060,627, entitled

10   "Device and Method For Forming Hands of Randomly Arranged Cards", filed on April 15, 1998 and incorporated herein by reference.

In the following description, the Appendices and the claims, any references to the terms right and left, top and bottom, upper and lower and horizontal and vertical are to be read and understood with their conventional meanings and with reference to viewing the apparatus

15   generally from the front as shown in Figure 1.

Referring then to the Figures, particularly Figures 1, 3 and 4, the card handling apparatus 21 of the present invention includes a card receiver 26 for receiving a group of cards to be randomized or shuffled, a single stack of card-receiving compartments 28 (see Figures 4 and 9) generally adjacent to the card receiver 26, a card moving or transporting mechanism 30 (see

20   Figures 3 and 4) between and linking the card receiver 26 and the compartments 28, and a processing unit, indicated generally at 54 in Figure 3, that controls the apparatus 21. The apparatus 21 includes a second card mover 192 (see Figures 4, 8 and 8a) for emptying the compartments 28 into a second card receiver 36.

Referring to Figures 1 and 2, the card handling apparatus 21 includes a removable,

25   substantially continuous exterior housing shroud 40. The shroud 40 may be provided with appropriate vents 42 for cooling. The card receiver or initial loading region, indicated generally at 26 is at the top, rear of the apparatus 21, and the second card receiver 36 is at the front of the apparatus 21. Controls and/or display features 32 are generally at the rear or dealer-facing side of the machine 21. Figure 2 provides a view of the rear of the apparatus 21 and more clearly

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shows the display and control inputs and outputs 32, including power input and communication port 46.

Figure 3 depicts the apparatus 21 with the shroud 40 removed, as it might be for servicing or programming, whereby internal components may be visualized. The apparatus includes a generally horizontal frame floor 50 for mounting and supporting operational components. A control (input and display) module 56 is cantilevered at the rear of the apparatus 21, and is operably connected to the operational portions of the apparatus 21 by suitable wiring or the like. The control module 56 may carry the microprocessor (not shown), or the microprocessor is preferably located on processing unit 54 on the frame 50 inside the shroud 40. The inputs and display portion 44 of the module 56 are fitted to corresponding openings in the shroud 40, with associated circuitry and programming inputs located securely with the shroud 40 when it is in place as shown in Figures 1 and 2.

In addition, the present invention generically and specifically a card handler or shuffling device comprising:

a card staging area for receiving cards to be handled;

a plurality of card-receiving compartments, the card staging area (and a card mover) and the compartments are relatively movable;

a card mover generally between the staging area and the compartments for moving a card from the staging area into one of the compartments;

a microprocessor programmed to identify each card in the card staging area and to relatively actuate the card mover to move an identified card to a randomly selected compartment, wherein the microprocessor is programmable to deliver a selected number of cards to a compartment;

a drive system responsive to the microprocessor for relatively moving the compartments; and

a counting system for counting cards within specified areas within the card handler.

The terms "relatively actuate" and relatively move" are used in this description to emphasize the point that there should be relative movement between the compartments and the card mover/card staging area. Relative movement may be caused by movement of the rack of compartments only, movement of the card mover only, or by movement of both the rack of compartments and the card mover/staging area. The alignment of the card feeder and the feeding of the card may be done as separate (in time) steps or as contemporaneous steps, with either the feeder (card

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mover) moving and being fed a card at the same time or having the card fed at a distinct time from the moving of the feeder (card mover).

The card handler counting system preferably counts cards entering and leaving the plurality of card-receiving compartments. There may be present a card moving system to move cards from the plurality of card-receiving compartments to a second card receiving area. The card handler may have the counting system count cards entering and leaving the plurality of card-receiving compartments and cards entering and leaving the second card receiving area, and the counting system may maintain a rolling count of the cards within both the plurality of card-receiving compartments and the second card receiving area. This format could use inputs operably coupled to the microprocessor for inputting information into the microprocessor.

A playing card handler according to the present invention may also comprise:

a stack of compartments for accumulating cards in at least one compartment;

a microprocessor programmed to randomly select the compartment which receives each card in a manner sufficient to accomplish randomly arranging the cards in each compartment, wherein the microprocessor is programmable to deliver a selected number of cards to a selected number of compartments;

a card staging area for receiving a stack of cards to be handled, wherein the stack of compartments and the card staging area are movable relative to each other, by any one being independently movable or by both being movable;

card moving means responsive to output signals from the microprocessor for moving between the staging area and the stack of mixing compartments;

a card mover for moving cards from the compartments to a second card receiver; and

the microprocessor performing as a counting system for counting cards within specified areas within the card handler.

This apparatus may further comprise a data storage medium accessible by the processing unit, wherein the data storage medium has a program stored on it, and wherein the program is configured to cause the processing unit to cause the card moving means to move cards from the

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staging area to random compartments. The microprocessor may monitor, record and control a display for the use of the apparatus. The apparatus may further comprise at least one sensor for monitoring the movement of cards and the data storage medium may be further configured to cause the processing unit to detect a card jam.

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A method according to the present invention for substantially continuously replenishing a group of processed cards may comprise:

providing a card receiver for receiving cards to be processed;

providing a single stack of card-receiving compartments generally adjacent to the card

10   receiver and means for moving the stack relative to a card moving mechanism;

providing a card-moving mechanism between the card receiver and the stack for moving cards from the card receiver to the card-receiving compartments;

providing a second card receiver for receiving processed cards;

providing a second card moving mechanism for moving cards from the compartments to the

15   second card receiver; and

counting cards within specified areas within the card handler.

CARD RECEIVER

Referring to Figures 3 and 4, the card receiver or loading region 26 includes a card

20   receiving well 60. The well 60 is defined by upright, generally parallel card guiding side walls 62 and a rear wall 64. It includes a floor surface 66 pitched or angled downwardly toward the front of the apparatus 21. Preferably, the floor surface is pitched from the horizontal at an angle ranging from approximately five to twenty degrees, with a pitch of seven degrees being preferred. A removable, generally rectangular weight or block 68 is freely and slidably received

25   in the well 60 for free forward and rearward movement along the floor surface 66. Under the influence of gravity, the block 68 will tend to move toward the forward end of the well 60. The block 68 has an angled, card-contacting front face 70 for contacting the back (i.e., the bottom of the bottommost card) of a group of cards placed into the well, and urges cards (i.e., the top card of a group of cards) forward into contact with the card transporting mechanism 30. The card-

30   contacting face 70 of the block 68 is at an angle complimentary to the floor surface 66 of the

well 60, for example, an angle of between approximately 10 and 80 degrees, and preferably at an angle of 40 degrees. This angle and the weight of the block keep the cards urged forwardly against the transport mechanism 30. The selected angle of the floor 66 and the weight of the block 68 allow for the free floating rearward movement of the cards and the block 68 to

5   compensate for the rearward force and movement generated as the top or forwardmost card contacts the transport mechanism 30 and begins to move. The well 60 includes a card present sensor 74 to sense the presence or absence of cards in the well 60. Preferably, the block 68 is mounted on a roller 69 for easing the movement of the block 68, and/or the floor 66 and the bottom of the block may be formed of or coated with friction reducing material. As shown in

10   Figure 6, the block 68 may have a thumb or finger receiving notch 71 to facilitate moving it.

CARD RECEIVING COMPARTMENTS

The assembly or stack of card receiving compartments 28 is depicted in Figures 4, 9 and 10, and may also be referred to as a rack assembly. Referring back to Figure 3, the rack assembly 28 is housed in an elevator and rack assembly housing 78 generally adjacent to the well

15   60, but horizontally spaced therefrom. An elevator motor 80 is provided to position the rack assembly 28 vertically under control of a microprocessor, in one embodiment, generally part of the processing unit 54. The motor 80 is linked to the rack assembly 28 by a continuous resilient member such as a timing belt 82. Referring to Figure 10, which depicts a portion of the rack assembly 28 and how it may be assembled, the rack assembly 28 includes a bottom plate 92, a

20   left hand rack 94 carrying a plurality of half shelves 96, a right hand rack 98 including a plurality of half shelves 100 and a top plate 102. Together the right and left hand racks 94, 98 and their respective half shelves 96, 100 form the individual plate-like shelf pieces 104 for forming the top and bottom walls of the individual compartments 106. The rack assembly 28 is operably mounted to the apparatus 21 by a left side rack plate 107 and a linear guide 108. It is attached to

25   the guide by a guide plate 110. The belt 82 links the motor 80 to a pulley 112 for driving the rack assembly 28 up and down. A hall effect switch assembly 114 is provided to sense the bottom position of the rack assembly 28.

Figure 9 depicts a rack assembly 28 having 19 individual compartments 106 for receiving cards. Generally speaking, a larger number of individual compartments is preferred over fewer

30   compartments, with 17 to 19 compartments being most preferred for randomizing four decks of

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cards, but it should be understood that the present invention is not limited to a rack assembly of seventeen to nineteen compartments. Preferably, the compartments 106 are all substantially the same size, i.e., the shelves 104 are substantially equally vertically spaced from each other. Figure 7 shows, in part, a top plan view of one of the shelf members 104 and that each includes a

5   pair of rear tabs 124 located at respective rear corners of the shelf member 104. The tabs 124 are for card guiding, and help make sure cards are moved from the transporting mechanism 30 into the rack assembly 28 without jamming by permitting the leading edge of the card to be guided downwardly into the compartment 106 before the card is released from the card moving mechanism 30. Generally, it is desirable to mount the shelves as close to the transporting

10   mechanism 30 as possible.

       Figure 11 depicts an alternative embodiment of plate-like shelf members 104 comprising a single-piece plate member 104'. An appropriate number of the single-piece plates, corresponding to the desired number of compartments 106 would be connected between the side walls of the rack assembly 28. The plate 104' depicted in Figure 11 includes a curved or arcuate

15   edge portion 126 on the rear edge 128 for removing cards or clearing jammed cards, and it includes the two bilateral tabs 124, also a feature of the shelf members 104 of the rack assembly 28 depicted in Figure 7. The tabs 124 act as card guides and permit the plate-like shelf members 104 forming the compartments 106 to be positioned as closely as possible to the card transporting mechanism 30 to ensure that cards are delivered correctly into a compartment 106

20   even though they may be warped or bowed.

       Referring back to Figure 5, an advantage of the plates 104 (and/or the half plates 96, 100) forming the compartments 106 is depicted. As shown in more detail in Figure 5a, each plate 104 includes a beveled or angled underside rearmost surface 130 in the space between the shelves or plates 104, i.e., in each compartment 106. Referring to Figure 5, the distance between the

25   forward edge 134 of the plate 104 and the forward edge 132 of the bevel 130 is preferably less than the width of a typical card. The leading edge 136 of a card being driven into a compartment 106 hits the beveled surface 130 and falls down on the top of cards already in the compartment 106 so that it comes to rest properly in the compartment 106 or on the uppermost card of cards already delivered to the compartment. To facilitate a bevel 130 at a suitable angle 137, a

30   preferred thickness for the plate-like shelf members 104 is approximately 3/32 of an inch, but

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/8

this thickness and/or the bevel angle can be changed or varied to accommodate different sizes of cards, such as poker and bridge cards. Preferably, the bevel angle 137 is between approximately ten and 45 degrees, and more preferably is between approximately fifteen and twenty degrees. Whatever bevel angle and thickness is selected, it is preferred that cards C should come to rest

5   with their trailing edge at least even with and, preferably rearward of edge 132 of the plate-like shelf members 104.

The front of the rack assembly 28 is closed by a removable cover 142, which may be formed of opaque, transparent or semi-transparent material such as suitable metal or plastic.

CARD MOVING MECHANISM

10   Referring to Figures 4, 5 and 6, a preferred card transporting or moving mechanism 30 linking the card receiving well 60 and the compartments 106 of the rack assembly 28 includes a card pickup roller assembly 150. The card pick-up roller assembly 150 is located generally at the forward portion of the well 60. The pick-up roller assembly 150 includes friction rollers 151A, 151B supported by a bearing mounted axle 152 extending generally across the well 60

15   whereby the card contacting surface of the roller is in close proximity to the forward portion of the floor surface 66. The roller assembly 150 is driven by a pick up motor 154 operably coupled to the axle 152 by a suitable continuous connector 156 such as a belt or chain. The card-contacting surface of the roller may be generally smooth, it may be textured or it may include one or more finger or tab-like extensions, as long as card gripping and moving is not impaired.

20   With continued reference to Figures 4, 5 and 6, the preferred card moving mechanism 30 includes a pinch roller card accelerator or speed-up system 160 located adjacent to the front of the well 60 generally between the well 60 and the rack assembly 28 forwardly of the pick-up roller assembly 150. As shown in Figure 7, it is the speed-up system 160 which nests close to the shelves 104 between the tabs 124 of the shelves. Referring back to Figures 4, 5 and 6, the

25   speed-up system 160 comprises a pair of axle supported, closely adjacent speed-up rollers, one above the other, including a lower roller 162 and an upper roller 164. The upper roller 164 may be urged toward the lower roller 162 by a spring assembly 166 (Figure 4) or the roller 162 and 164 may be fixed in slight contact or near to contact and formed of a generally firm yet resilient material which gives just enough to admit a card. Referring to Figure 4, the lower roller 162 is a

30   driven by a speed-up motor 166 operably linked to it by a suitable connector 168 such as a belt

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or a chain. The mounting for the speed-up rollers also supports a rearward card in sensor 172 and a forward card out sensor 176. Figure 5 is a largely representational view depicting the relationship between the card receiving well 60 and the card transporting mechanism 30, and also shows a card C being picked up by the pickup roller assembly 150 and being moved into the

5 pinch roller system 160 for acceleration into a compartment 104 of the rack assembly 28.

In one embodiment, the pick-up roller assembly 150 is not continuously driven, but rather indexes and includes a one-way clutch mechanism. After initially picking up a card and advancing it into the speed-up system 160, the pick-up roller motor 154 stops when the leading edge of a card hits the card out sensor 176, but the roller assembly 150 free-wheels as a card is

10 accelerated from under it by the speed-up system 160. In one embodiment, the speed-up pinch system 160 is continuous in operation once a cycle starts. When the trailing edge of the card passes the card out sensor 176, the rack assembly 28 moves the next designated compartment into place for receiving a card. The pick up motor 154 then reactuates.

Additional components and details of the transport mechanism 30 are depicted in Figure

15 6, an exploded assembly view thereof. In Figure 6 the inclined floor surface 66 of the well 60 is visible, as are the axle mounted pickup and pinch roller assemblies 150, 160, respectively, and their relative positions.

Referring to Figures 4 and 5, the transport assembly 30 includes a pair of generally rigid stopping plates including an upper stop plate and a lower stop plate 180, 182, respectively. The

20 plates 180, 182 are fixedly positioned between the rack assembly 28 and the speed-up system 160 immediately forward of and above and below the pinch rollers 162, 164. The stop plates 180, 182 stop the cards from rebounding or bouncing rearwardly, back toward the pinch rollers, after they are driven against and contact the cover at the front of the rack assembly 28.

PROCESSING/CONTROL UNIT

25 Figure 14 is a block diagram depicting an electrical control system which may be used in one embodiment of the present invention. The control system includes a controller 360, a bus 362, and a motor controller 364. Also represented in Figure 14 are inputs 366, outputs 368, and a motor system 370. The controller 360 sends signals to both the motor controller 364 and the outputs 368 while monitoring the inputs 366. The motor controller 364 interprets signals

30 received over the bus 362 from the controller 360. The motor system 370 is driven by the motor

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controller 364 in response to the commands from the controller 360. The controller 360 controls the state of the outputs 368 by sending appropriate signals over the bus 362.

In a preferred embodiment of the present invention, the motor system 370 comprises motors that are used for operating components of the card handling apparatus 21. Motors

5   operate the pick-up roller, the pinch, speed-up rollers, the pusher and the elevator. The gate and stop may be operated by a motor, as well. In such an embodiment, the motor controller 364 would normally comprise one or two controllers and driver devices for each of the motor used. However, other configurations are possible.

The outputs 368 include, for example, alarm, start, and reset indicators and inputs and

10   may also include signals that can be used to drive a display device (e.g., a LED display - not shown). Such a display device can be used to implement a timer, a card counter, or a cycle counter. Generally, an appropriate display device can be configured and used to display any information worthy of display.

The inputs 366 include information from the limit switches and sensors described above.

15   Other inputs might include data inputted through operator or user controls. The controller 360 receives the inputs 366 over the bus 362.

Although the controller 360 can be any digital controller or microprocessor-based system, in a preferred embodiment, the controller 360 comprises a processing unit 380 and a peripheral device 382 as shown in Figure 16. The processing unit 380 in the preferred embodiment may be

20   an 8-bit single-chip microcomputer such as an 80C52 manufactured by the Intel Corporation of Santa Clara, California. The peripheral device 382 may be a field programmable micro controller peripheral device that includes programmable logic devices, EPROMs, and input-output ports. As shown in Figure 15, peripheral device 382 interfaces the processing unit 380 to the bus 362.

25   The series of instructions stored in the controller 360 is shown in Figure 15 and 16 as program logic 384. In a preferred embodiment, the program logic 384 is RAM or ROM hardware in the peripheral device 382. (Since the processing unit 380 may have some memory capacity, it is possible that some of the instructions are stored in the processing unit 380.) As one skilled in the art will recognize, various implementations of the program logic 384 are

30   possible. The program logic 384 could be either hardware, software, or a combination of both.

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Hardware implementations might involve hardwired code or instructions stored in a ROM or RAM device. Software implementations would involve instructions stored on a magnetic, optical, or other media that can be accessed by the processing unit 380. Under certain conditions, it is possible that a significant amount of electrostatic charge may build up in the card handler 21.

Significant electrostatic discharge could affect the operation of the handler 21. It may, therefore, be helpful to isolate some of the circuitry of the control system from the rest of the machine. In one embodiment of the present invention, a number of optically-coupled isolators are used to act as a barrier to electrostatic discharge.

As shown in Figure 16, a first group of circuitry 390 can be electrically isolated from a second group of circuitry 392 by using optically-coupled logic gates that have light-emitting diodes to optically (rather than electrically) transmit a digital signal, and photo detectors to receive the optically transmitted data. An illustration of electrical isolation through the use of optically-coupled logic gates is shown in Figure 17, which shows a portion of Figure 16 in detail. Four Hewlett-Packard HCPL-2630 optocouplers (labeled 394, 396, 398 and 400) are used to provide an 8-bit isolated data path to the output devices 368. Each bit of data is represented by both an LED 402 and a photo detectors 404. The LEDs emit light when forward biased, and the photo detectors detect the presence or absence of the light. Data is thus transmitted without an electrical connection.

SECOND CARD MOVING MECHANISM

Referring to Figures 4, 8 and 8a, the apparatus 21 includes a second card moving mechanism 34 comprising a reciprocating card unloading pusher 190. The pusher 190 includes a substantially flexible pusher arm 192 in the form of a rack having a plurality of linearly arranged apertures 194 along its length. The arm 192 is operably engaged with the teeth of a pinion gear 196 driven by an unloading motor 198 controlled by the microprocessor. At its leading or card contacting end, the pusher arm 192 includes a blunt, enlarged card-contacting head end portion 200. The end portion 200 is greater in height than the spacing between the shelf members 104 forming the compartments 106 to make sure that all the cards contained in a compartment are contacted and pushed as it is operated, even bowed or warped cards, and includes a pair outstanding guide tabs 203 at each side of the head 200 for interacting with the second card receiver 36 for helping to insure that the cards are moved properly and without jamming from the

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compartments 106 to the second card receiver 36. The second card moving mechanism 34 is operated periodically (upon demand) to empty stacks of cards from compartments, i.e., compartments which have received a complement of cards or a selectable minimum number of cards.

5   **SECOND CARD RECEIVER**

When actuated, the second card moving mechanism 34 empties a compartment 106 by pushing cards therein into a second card receiver 36, which may take the form of a shoe-like receiver, of the apparatus 21. The second card receiver 36 is shown in Figures 1, 4, 14 and 16, among others.

10   Referring to Figures 12 and 13, the second card receiver 36 includes a shoe-like terminal end plate 204 and a card way, indicated generally at 206, extending generally between the rack assembly 28 and the terminal end plate 204. When a compartment 106 is aligned with the card way 206, as shown in Figure 12, the card way 206 may be thought of as continuous with the aligned compartment. Referring to Figure 4, an optional cover operating motor 208 is positioned

15   generally under the card way 206 for raising and lowering a powered cover 142 if such a cover is used.

Referring back to Figures 4, 12 and 13, the card way 206 has a double curved, generally S-shaped surface and comprises a pair of parallel card guiding rails 210, 212, each having one end adjacent to the rack assembly 28 and a second end adjacent to the terminal end 204. Each

20   rail 210, 212 has a card-receiving groove 213. A S-shaped card support 211 is positioned between the rails 210, 212 for supporting the central portion of a card or group of cards as it moves down the card way 206. A pair of card-biasing springs 215 are provided adjacent to the rails 210, 212 to urge the cards upwardly against the top of the grooves 213 to assist in keeping the all the cards in the group being moved into the second receiver 36 in contact with the pusher

25   190. The curves of the card way 206 help to guide and position cards for delivery between cards already delivered and the card-pushing block 214, which is generally similar to the block 68. The second curve portion 207 in particular helps position and align the cards for delivery between cards already delivered and the card pushing block 214.

The second card receiver 36 is generally hollow, defining a cavity for receiving cards and

30   for containing the mirror image rails 210, 212, the motor assembly 208 and a freely movable

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card pushing block 214. Referring to Figure 12, the block 214 has an angled, front card contacting face 216, the angle of which is generally complementary to the angle of the terminal end plate 204. The block 214 has a wheel or roller 218 for contacting the sloping or angled floor 220 of the second card receiver 36 whereby the block moves freely back and forth. The free

5   movement helps absorb or accommodate the force generated by the dealer's hand as he deals, i.e., the block 214 is free to bounce rearwardly. A suitable bounce limit means (such as a stop 221 mounted on the floor 220 or a resilient member, not shown) may be coupled near the block 214 to limit its rearward travel. Referring to Figure 4, a suitable receiver empty sensor 222 may be carried by the terminal plate 204 at a suitable location, and a card jammed sensor 224 may be

10 provided along the card way 206 adjacent to the guide rails 210, 212. The receiver empty sensor 222 is for sensing the presence or absence of cards. The sensor 223 senses the location of block 214 indicating the number of cards in the buffer, and may be operably linked to the microprocessor or directly to the pusher motor 198 for triggering the microprocessor to actuate the pusher 190 of the second transport assembly 34 to unload one or more groups of cards from

15 the compartments 106.

As depicted in Figure 13, the terminal plate 204 may include a sloped surface 204'. The sloped surface 204' has a raised portion closest to the terminal plate 204, and that portion fits generally under a notch 205' in the terminal plate 204 for receiving a dealer's finger to facilitate dealing and to help preserve the flatness of the cards. The shoe 204', the terminal plate 204 and a

20 removable card way cover 209 may be formed as a unit, or as separable individual pieces for facilitating access to the inside of the second receiver 36.

Figure 12 is a largely representational view depicting the apparatus 21 and the relationship of its components including the card receiver 26 for receiving a group of new or played cards for being shuffled for play, including the well 60 and block 68, the rack assembly

25 28 and its single stack of card-receiving compartments 106, the card moving or transporting mechanism 30 between and linking the card receiver 26 and the rack assembly 28, the second card mover 190 for emptying the compartments 106 and the second receiver 36 for receiving randomized or shuffled cards.

OPERATION/ USE

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Appendix B outlines one embodiment of the operational steps or flow of the method and apparatus of the present invention. The start input is actuated and the apparatus 21 homes (see Appendix B). In use, played or new cards to be shuffled or reshuffled are loaded into the well 60 by moving the block 68 generally rearwardly or removing it. Cards are placed into the well 60

5   generally sideways, with the plane of the cards generally vertical, on one of the long side edges of the cards (see Figures 5 and 12). The block 68 is released or replaced to urge the cards into an angular position generally corresponding to the angle of the angled card contacting face of the block, and into contact with the pick-up roller assembly 150. As the cards are picked up, i.e., after the separation of a card from the remainder of the group of cards in the well 60 is started, a

10   card is accelerated by the speed-up system 160 and spit or moved through a horizontal opening between the plates 180, 182 and into a selected compartment 106. Substantially simultaneously, movement of subsequent cards is underway, with the rack assembly 28 position relative to the cards being delivered by the transport mechanism 30 being selected and timed by the microprocessor whereby selected cards are delivered randomly to selected compartments until

15   the cards in the well 60 are exhausted. In the unlikely event of a card jam during operation, for example, if one of the sensors is blocked or if the pusher hits or lodges against the rack assembly 28, the apparatus 21 may flow automatically or upon demand to a recovery routine which might include reversal of one or more motors such as the pick-up or speed-up motors, and/or repositioning of the rack assembly 28 a small distance up or down.

20   Upon demand from the receiver sensor 222, the microprocessor randomly selects the compartment 106 to be unloaded, and energizes the motor which causes the pusher 190 to unload the cards in one compartment 106 into the second card receiver 36. The pusher is triggered by the sensor 222 associated with the second receiver 36. It should be appreciated that each cycle or operational sequence of the machine 21 transfers all of the cards placed in the well 60 each time,

25   even if there are still cards in some compartments 106. In one embodiment, the apparatus 21 is programmed to substantially constantly maintain a "buffer" (see Figure 12 wherein the buffer is depicted at "B") of a selected number of cards, for example 20 cards, in the second receiver. A buffer of more or less cards may be selected.

    In operation, when sensor 74 detects cards present, the entire stack of unshuffled cards in

30   the card receiver 26 is delivered one by one to the card receiving compartments 106. A random

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number generator is utilized to select the compartment which will receive each individual card. The microprocessor is programmed to skip compartments that hold the maximum number of cards allowed by the program. At any time during the distribution sequence, the microprocessor can be instructed to activate the unloading sequence. All compartments 106 are randomly

5   selected.

It is to be understood that because cards are being fed into and removed from the apparatus 21 on a fairly continuous basis, that the number of cards delivered into each compartment 106 will vary.

Preferably, the microprocessor is programmed to randomly select the compartment 106 to

10   be unloaded when more cards are needed. Most preferably, the microprocessor is programmed to skip compartments 106 having seven or fewer cards to maintain reasonable shuffling speed.

It has been demonstrated that the apparatus of the present invention provides a recurrance rate of at least 4.3%, a significant improvement over known devices.

In one exemplary embodiment, the continuous card shuffling apparatus 21 of the present

15   invention may have the following specifications or attributes which may be taken into account when creating an operational program.

Machine Parameters - 4 Deck Model:

1.   Number of compartments 106: variable between 13-19;

2.   Maximum number of cards/compartment: variable between 10-14;

20   3.   Initial number of cards in second card receiver: 20-24;

4.   Theoretical capacity of the compartments: 147-266 cards (derived from the number of compartments x the preferred maximum number of cards/compartment);

5.   Number of cards in the second card receiver 36 to trigger unloading of a compartment: variable between 6-10;

25   6.   Delivery of cards from a compartment 106 is not tied to a predetermined number of cards in a compartment (e.g., a compartment does not have to contain 14 cards to be unloaded). The minimum number of cards to be unloaded may range from between 4 to 7 cards and it is preferred that no compartment 106 be completely full (i.e., unable to receive additional cards) at any time.

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In use, it is preferred that the apparatus 21 incorporates features, likely associated with the microprocessor, for monitoring and recording the number of cards in each group of cards being moved into the second card receiver 36, the number of groups of cards moved, and the total number of cards moved.

5

In one embodiment, taking into account the above set forth apparatus attributes, the apparatus 21 may follow the following sequence of operations:

Filling the machine with cards:

10 1.   The dealer loads the well 60 with pre-shuffled cards;

2.   Upon actuation, the apparatus 21 randomly loads the compartments 106 with cards from the well, one card at a time, picking cards from the top of the cards in the well;

3.   When one of the compartments 106 receives a predetermined number of cards, unload that compartment 106 into the second card receiver 36;

15 4.   Continue with #2. No compartment loading during second receiver loading.;

5.   When a second compartment 106 receives a predetermined number of cards, unload that compartment 106 into the second card receiver 36, behind cards already delivered to the second receiver 36;

6.   The dealer continues to load cards in the well 60 which are randomly placed into the

20   compartments 106; and

7 .   Repeat this process until the initial number of cards in receiver 36 has been delivered.

In another practice of the present invention, there are three (or more or fewer) separate methods of filling the shoe. The method may be preferably randomly selected each time the

25 machine is loaded. Step 3 (above) outlines one method. A second method is described as follows: Prior to the beginning of the filling cycle, a distinct number of compartments (e.g., four compartments) are randomly selected, and as those compartments reach a minimum plurality number of cards (e.g., six cards), those compartments unload as they are filled to at least that minimum number. The second method delays the initial loading of the shoe as compared to the

30 first method. In a third method, as cards are loaded into the rack assembly, no cards unload until

there are only a predetermined plurality number (e.g., four) compartments remaining with a maximum number (e.g., six or fewer) of cards. When this condition is met, the shoe loads from the last plurality number (e.g., four) of compartments as each compartment is filled with a minimum number (e.g., six cards) of cards. This third member delays loading even more as compared to the first and second methods.

Continuous operation

1   The dealer begins dealing;

2.   When the number of cards in the second card receiver 36 goes down to a predetermined number sensed by sensor 223, unload one group of cards from one of the compartments 106 (randomly selected);

3.   As cards are collected from the table, the dealer loads cards into the receiver 60. These cards are then randomly loaded into compartments 106. In case a compartment has received the maximum number of cards allowed by the program, if selected to receive another card, the program will skip that compartment and randomly select another compartment; and

4.   Repeat #2 and #3 as play continues. It is preferable that the ratio of cards out or in play to the total number of cards available should be low, for example approximately 24:208.

Another concern in continuous shufflers is the fact that there has been no ability to provide strong security evaluation in the continuous shufflers, because of the very fact that the cards are continuously being reshuffled, with cards present within and without the shuffler. This offers an increased risk of cards being added to the deck by players or being removed and held back by the player. This is a particular concern in games where the player is allowed to contact or pick up cards during play (e.g., in certain poker-type games and certain formats for blackjack). The present invention provides a particular system wherein the total number of cards in play at the table may be verified with minimum game interruption. This system may be effected by a number of different procedures, each of which is exemplary and is not intended to limit the options or alternatives that may be used to effect the same or similar results.

One method of effecting this method comprises a continuous counting, analysis, reporting based on at least some (but not necessarily all) the following information provided to

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the microprocessor: the total initial number of cards provided to the shuffler, the number of cards dealt to each player, the number of cards dealt in a complete game, the number of cards dealt in a round, the total number of cards dealt out since new cards were introduced, the total number of cards returned to the shuffler, the difference between the number of cards dealt out and the

5   number of cards returned to the shuffler, specific cards removed and re-supplied to the shuffler, and the like. It must be noted that continuous shufflers are intended to run with no total replacement of the cards to be shuffled, except when the used decks are replaced with new decks. As opposed to the more common batch shufflers, where a specific number of decks are shuffled, the shuffled decks are cut, the game is played with cards distributed until the cut is reached, and

10   then the decks are reinserted into the shuffler for shuffling, the continuous shuffler maintains a large stock of cards within the shuffler assembly, with cards used in the play of a hand being reinserted into the assembly to be combined with the stock of cards that are shuffled and added to the shoe for distribution to the players. This creates the card distribution pattern where the cards are ordinarily distributed between various sections of a shuffler (e.g., a feeder, a separation

15   rack, a shoe, etc.), a manually stored portion of cards on the table, including for example excess cards, discards, cards used in part or in whole in the play of the hand, and cards held by a player. This pattern makes it very difficult to maintain surveillance of the cards and maintain security with respect to the number or type of cards present on the table.

One type of continuous shuffler that is particularly useful in the practice of the present

20   invention comprises a shuffler with a feeder zone, separation or shuffling zone (or "rack," depending upon the design) and shoe zone. This shuffling zone could be any type of shuffling zone or shuffling process, including those constructions known in the art, wherein the novel feature of keeping a card count of cards specifically within a specific zone within the system is maintained. This is opposed to a construction where cards are merely counted in a batch as they

25   are initially fed into a machine or into a zone. In this practice, for example, a constant count of cards is maintained in the shuffling zone by counting the cards inserted, the cards removed, and additional cards inserted into the zone. The feeder zone is a section where cards are inserted into the shuffling apparatus, usually stacked in a collection of cards to be shuffled. The feeder zone is a storage area in the shuffling device that stores unshuffled cards and provides or feeds those

30   cards into a shuffling function. The shuffling or separation zone is a region within the shuffling

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or card handling apparatus where unshuffled cards are randomly distributed or separated into compartments or receiving areas to form subsets of randomly distributed cards from the unshuffled cards provided from the feeder zone. The shuffling zone could be any region within the device that accomplishes randomization of the cards while keeping track of the actual

5   number of cards within the zone. The shoe is the section of the shuffling apparatus where shuffled cards are stored for delivery to a) players, b) the dealer and/or to c) discard or excess piles. The shoe may receive limited numbers of cards that are replenished (usually automatically) from the separation area. The general operation of this type of system would be as follows, with various exemplary, but non-limiting options provided.

10   Cards are inserted into the feeder region of the shuffler. A number of cards are fed, usually one at a time, into the shuffling or separation zone (hereinafter referred to as the 'shuffling zone'). The number of cards may be all of the cards (e.g., 1, 2, 3, 4,5 or more decks depending upon the size of the apparatus and its capacity) or less than all of the cards. The microprocessor (or a networked computer) keeps track of the number of cards fed from the

15   feeder zone into the shuffling zone. The shuffling zone may comprise, for example, a number of racks, vertical slots, vertical compartments, elevator slots, carousel slots, carousel compartments, or slots in another type of movable compartments (movable with respect to the feeding mechanism from the feeder, which could include a stationary separation department and a movable feeder).

20   The shuffling zone can also include a completely different style of randomization or shuffling process, such as the shuffling processes shown in Sines U.S. Patents Nos. 5,676,372 and 5,584,483. Although the described apparatus is a batch-type shuffler, the device could be easily modified to deliver cards continuously, with a resupply of spent cards. The device, for example, could be adapted so that whenever discards are placed in the infeed tray, the cards are

25   automatically fed into the shuffling chamber. The programming could be modified to eject hands, cards or decks on demand, rather than only shuffling multiple decks of cards.

In that type of apparatus, a stack of cards is placed up on edge in the shuffling zone, with one group of card edges facing upwardly, and the opposite edges supported by a horizontal surface defining a portion of the shuffling chamber. The stack of cards is supported on both

30   sides, so that the group of cards is positioned substantially vertically on edge.

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A plurality of ejectors drive selected cards out of the stack by striking an edge of a card, sending the card through a passage and into a shuffled card container. Shuffling is accomplished in one shuffling step. In this example, by equipping the shuffler with a feed mechanism that is capable of counting each card that is loaded, including the cards added into the stack during

5   operation, and counting each card ejected from the stack, it is possible to keep track of the total number of cards within the shuffling zone at any given time.

In another example of the present invention, the shuffling chamber may be similar to that shown in U.S. Patent No. 4,586,712 (Lorber et al.). That device shows a carousel-type shuffling chamber having a plurality of radially disposed slots, each slot adapted to receive a single card.

10   A microprocessor keeps track of he number of or empty slots during operation (see column 7, lines 5-16).

In the example of a slot-type shuffling apparatus that accepts more than one card per shelf or slot, the cards are generally inserted into the particular type of compartments or slots available within the system on a random basis, one card at a time. This creates a series of

15   segments or sub-sets of cards that have been randomly inserted into the compartments or slots. These sub-sets are stored until they are fed into the shoe. The number of cards delivered from the shuffling zone into the shoe are also counted. In this manner, a constant count of the number of cards in the shuffling zone is maintained. At various times, either random times or at set intervals or at the command of the microprocessor, cards from the separation zone are directed

20   into the shoe. The microprocessor may signal the need for cards in the shoe by counting the number of cards removed from the shoe (this includes counting the number of cards inserted into the shoe and the number of cards removed from the shoe, so that a count of cards in the shoe may be maintained.

The process may then operate as follows. At all times (continually), the microprocessor

25   tracks the number of cards present in the shuffling zone. The dealer or other floor personnel activates the card verification process, halting the delivery of cards from the shuffling zone to the shoe. All cards on the table are then fed into the shuffling zone. The total cards in the shuffling zone (e.g., within the rack of compartments or slots) is determined. If there are cards in the shoe zone, those cards in the shoe are placed into the feeder zone. The cards are fed from the feeder

30   zone into the shuffling zone. The total of cards 1) originally in the shuffling zone area and 2) the

cards added to the feeder (and any cards already in the feeder that had not been sent to the shuffling zone before discontinuance of the handling distribution functions of the apparatus) and then fed into the separation zone are totaled. That total is then compared to the original number or programmed number of cards in the system. A comparison identifies whether all cards remain

5   within the system and whether security has been violated.

The system may indicate a secure system (e.g., the correct amount or number of cards) by a visual signal (e.g., LED or liquid crystal readout, light bulb, flag, etc.) or audio signal. Similarly, an insecure security condition (e.g., insufficient number of cards or plethora of cards) could be indicated by a different visual or audio signal, or could activate an unloading sequence.

10   If an insecure system notice is produced, there may be an optional function of reopening the system, recounting the cards, pausing and requiring an additional command prior to unloading, allowing the dealer to add additional cards subsequently found (e.g., retained at a player's position or in a discard pile), and then recounting some or all of the cards.

Alternatively, the cards in the shoe may also be accurately accounted for by the

15   microprocessor. That is, the microprocessor in the card-handling device of the present invention may count the cards in the shuffling zone and the cards in the shoe zone. This would necessitate that sensing be performed in at least two locations (from the feeder into the shuffling zone and out of the shoe) or more preferably in at least three locations (from the feeder to the shuffling zone, from the shuffling zone to the shoe zone, and cards removed from the shoe). Therefore,

20   the cards may be counted in at least three different ways within the apparatus and provide the functionality of maintaining a count of at least some of the cards secure within the system (that is, they cannot be removed from the system either without the assistance of the dealer, without triggering an unlock function within the system, or without visually observable activity that would be observed by players, the dealer, house security, or video observation).

25   For example, by counting and maintaining a count only within the shuffling zone, there is no direct access to the counted cards except by opening the device. By counting and maintaining a count within only the shuffling zone and the shoe, there is no direct access to the shuffling zone, and the cards may be removed from the shoe only by the dealer, and the dealer would be under the observation of the players, other casino workers, and video camera observation.

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The initiation of the count will cause a minor pause in the game, but takes much less time then a shuffling operation, including both a manual shuffling operation (e.g., up to five minutes with a six deck shoe) and a mechanical shuffling operation (1–4 minutes with a one to six deck shoe, which is usually performed during the play of the game with other decks), with the

5   counting taking one minute or less. The actual initiation of the count must be done by the dealer or other authorized personnel (e.g., within the house crew), although the card handling apparatus may provide a warning (based on time since the last count, the time of day, randomly, on a response to instructions sent from a house's control center, or with other programmed base) that a count should be performed. The count may be initiated in a number of ways, depending upon

10   where the count is being performed. A starting point would always be providing an initial total card count of all cards to be used with the shuffler. This can be done by the machine actually counting all the cards at the beginning of the game, by the dealer specifically entering a number for the total number of cards from a keypad, or by indicating a specific game that is defined by the number of cards used in the game.   The card verification process is preferably repeated

15   automatically whenever a card access point is opened (i.e., a shoe cover or door is opened).

As an example, a situation will be analyzed where the dealer decides that a count is to be made in the system where card count is maintained in the shuffling zone only. The dealer enters or presets a specific card count of 208 (two hundred and eight cards, four decks) into the microprocessor for the shuffler by pressing numbers on a keypad. The dealer will deactivate any

20   function of the machine that takes cards out of the shuffling zone will be deactivated. All cards on the table and in the shoe will then be added to the feeder zone. The cards will be automatically fed from the feeder zone into the shuffling zone and as a security function, each counted as it passes from the feeder zone to the shuffling zone. The count from this security function (or card totaling of cards not stored in the shuffling zone) will be added by the

25   microprocessor to the running or rolling shufling zone card count to provide a total card count. This total card count will then be compared to the preset value.

In another embodiment, a four deck game of Spanish Twenty-One® blackjack will be played. The dealer indicates the game to be played, and the card handling device (shuffler) indicates that 192 (one hundred and ninety-two, that is, 4 x 48 cards) cards will be used. After

30   one hour, the shuffler indicates that a count is required for security. The apparatus counts all

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cards in the shuffling zone and the shoe. The dealer closes a panel over the shoe to restrict access to the cards. The players' cards from the last hand, any discards, and all other cards not in the shuffling zone or shoe are then added to the feeder zone. The cards in the feeder zone are then fed into the shuffling zone and counted as the new card entry total. That new card entry

5   total is added to the rolling total for cards held within the combined shuffling zone and shoe. If the total is 192, a green light (or other color, or LED or liquid crystal display, or audio signal) will indicate that the proper count was achieved. If the count is inaccurate, a number of different procedures may be activated, after the card handling device has appropriately indicated that there is a discrepancy between the original or initial card count and the final card count performed on

10   command by the device. If the card count finds an insufficiency (e.g., fewer than 192 cards), the device may pause and the dealer and/or other casino employees will visually examine the table to see if cards were inadvertently left out of the count. The shuffler may also have the capability that it can abort a shuffling procedure and require a reloading of cards. If cards are found, the additional cards will be added to the feeder zone, an additional count initiated, and that second

15   count total added to the initial final card count total. If the total still lacks correspondence to the initial count, a further search may be made or security called to investigate the absence of cards. If the device is in a "pause" mode, the dealer may activaye an unloading process or a recounting process. A complete separate count may be made again by the machine and/or by hand to confirm the deficiency. The indication of an excess of cards is a more definitive initial

20   indication of a security issue. After such an indication, security would be called (either by floor personnel or by direct signal from the microprocesser) and an immediate count (mechanical and/or manual) of all the cards would be made. That issue would be resolved by the recount indicating the correct number of cards or an indication that an excess of cards actually exists.

The device can be constructed with not only a sensor or sensors to count the cards, but

25   also with a scanner or scanners that can read data on the cards to indicate actual card ranks and values. In this manner, particularly by reading the cards going into the shoe and being removed from the shoe, and/or reading the cards going into distinct compartments within the rack, the shuffler may monitor the actual cards within the apparatus, not merely the number of cards present. In this manner, as where a jackpot is awarded and the cards must be verified, the card

30   handling device may quickly verify the presence of all cards by number and rank within the

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decks. This can also be used to verify a hand by identifying which cards are specifically absent from the total of the cards originally inserted into the gaming apparatus. For example, the player's hand with a jackpot winning hand is left in front of the player. The apparatus is activated to count and identify cards. If the apparatus indicates that A-K-Q-J-10 of Hearts are

5 missing from the count and the player has the A-K-Q-J-10 of Hearts in front of her/him, then the jackpot hand is verified with respect to the security of the total of the playing cards. This is ordinarily done manually and consumes a significant amount of time.

The system of the present invention, in addition to allowing a security check on the number of cards present in the collection of decks, allows additional cards, such as promotional

10 cards or bonus cards, to be added to the regular playing cards, the total number of cards allowable in play modified to the number of regular playing cards plus additional (e.g., special) playing cards, allowing the shuffler to be modified for a special deck or deck(s) where there are fewer than normal cards (e.g., Spanish 21® blackjack game), or otherwise modified at the direction of the house. Therefore, the shuffler would not be limited to counting security for only

15 direct multiples of conventional 52 card playing decks. The shuffler may be provided with specific selection features wherein a game may be identified to the microprocessor and the appropriate number of cards for that game shall become the default security count for the game selected.

The present invention also describes a structural improvement in the output shoe cover to

20 prevent cards that are already within the shoe from interfering with the delivery of additional cards to the shoe. Figure 18 is a side elevational view of an output shoe 36 incorporating a gate 400 mounted for pivotal movement about an axis 410. The gate is of sufficient size and shape to retract and avoid obstruction of card way 206 when cards are moving into output shoe 36. A leading edge of a group of cards (not shown) contacts a first surface 412, moving gate 400

25 upwardly and substantially in a direction shown by arrow 414.

Once the group of cards passes into the shoe as shown by the position of the group of cards identified as B, the gate lowers by means of gravity to a second position shown in phantom at 416, blocking an opening to card way 206. With gate 400 in the lower resting position shown at 416, the dealer cannot inadvertently push cards B back into the card way 206

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when removing cards from the shoe 36. In this manner, the card way 206 is always capable of passing another group of cards to the shoe 36, assuring a continuous supply of cards.

A novel gravity feed/diverter system is described to reduce the potential for jamming and greatly reduces the chance for multiple cards being fed into the shuffling zone. In this feature, two separate features are present between the feeder zone and the separation zone as shown in Figure 19, which is a side view of a new feeder system with a novel design for a card separator that has the potential for reducing jamming and reducing the potential for multiple card feed when a single card is to be fed. The two features shown are adjacent to the feed tray 10. The feed tray 10 angled (at other than horizontal) with respect to the horizontal plane, but could also be substantially horizontal. The cards are urged towards the features on a discriminating barrier 500 by a pickoff roller 502. The pickoff roller 502 is shown here as driven by a motor 504. The shape of the lower edge of the discriminating barrier 500 is important because it discourages more than one card at a time from passing from the feed tray 10 to the separation zone 506. In the event that two cards are accidentally moved at the same time, the discriminating barrier 500, because of the height of a lower edge 508, the barrier will allow only one card to pass through, with the second (usually top most) card striking a braking surface 510 within the discriminating barrier 500 and retarding its forward movement.

The braking surfaces 510 are shown as two separate surfaces. However, the braking surface 510 can be a single continuous surface or more than two surfaces. It is important that a contact surface be provided that inhibits forward movement of a card resting upon another card. Since the friction between the two adjacent cards is minimal, the contact surface does not need to include sharply angled or substantially vertical surfaces to inhibit the forward movement of the card.

Another aspect of the separator of the present invention is the presence of a brake roller assembly 511. The assembly includes a stationary top roller 512 and a driven roller 514. The spacing between top roller 512 and bottom roller 514 is selected so that only one card can pass through the barrier 500. Single cards passing through roller assembly 511 pass through speed-up roller assembly 516, and into the shuffling zone.

Upon failing to advance, the apparatus may be programmed to treat the presence of the additional card (sensed by sensing elements within the shuffler, not shown) as a jam or as the

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next card to be advanced, without an additional card removed from the feeder zone. Separating the cards to assure that only one card at a time is fed is critical to obtaining accurate card counting and verification (unless the counting system is sufficiently advanced to enable distinguishing between the number of cards fed and counting that number of cards).

5   Other features and advantages of the present invention will become more fully apparent and understood with reference to the following specification and to the appended drawings and claims.

Appendix A
Motors, Switches and Sensors

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Item	Name	Description
1	ICPS	Input Card Present Sensor
2	RCPS	Rack Card Present Sensor
3	RHS	Rack Home Switch
4	RPS	Rack Position Sensor
5	UHS	Unloader Home Switch
6	DPS	Door Present Switch
7	RUTS	Rack Unload Trigger Sensor
8	CIS	Card In Sensor
9	COS	Card Out Sensor

10	GUS	Gate Up Switch
11	GDS	Gate Down Switch
12	SWRTS	Shoe Weight Release Trigger Sensor
13	SES	Shoe Empty Sensor
14	SJS	Shoe Jam Sensor
15	SS	Start Switch

Name	Description
POM	Pick-off Motor
SUM	Speed-up Motor
RM	Rack Motor
UM	Unloader Motor
SWM	Shoe Weight Motor
GM	Gate Motor
SSV	Scroll Switch – Vertical
SSH	Scroll Switch – Horizontal

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AL	Alarm Light

Display Noritake * CU20025ECPB - UIJ

Power SupplyShindengen * ZB241R8, or ZB241R7K2, ZB241R7 or EOS Corporation

ZUC45TS24E or Qualtek Electric 862-06/002 or Delta 06AR1

Linear GuideTHK * RSR12ZMUU + 145 M, or 2RSR12Z MUU + 229I M

Comm. PortDigi * HR021 - ND

Power SwitchDigi * SW 323 - ND

Power EntryBergquist * LT - 101 - 3P

Appendix B

Homing/Power-up

1.	Unloader Home	
2.	Door Present	
3.	Gate Closed	
4.	Card Out Sensor (COS) Clear	
5.	Rack Empty and Home	
6.	Input Shoe Empty	

7. Shoe Empty	
8. Card in Sensor (CIS) Clear.	
9. Shoe Jam Sensor Clear	

An extremely desirable feature of the shuffler of the present invention is the system of monitoring and moving cards. Figure 20 identifies the sensor and motor locations for a preferred embodiment of the invention.

5   Representative sensors are optical sensors with a light emitter and receiver. An example of a suitable sensor is a model number EE-SPY401 available from Omron of Schaumburg, Illinois. The space constraints and the specific function of each sensor described below are factors to be considered when selecting a sensor. Although optical sensors are described below, it is possible to use other types of sensors such as proximity sensors, pressure sensors, readers for
10   information installed on the cards (e.g., magnetic readers) and the like.

Sensor 600 is the dealing sensor. This sensor is capable of generating a signal for every card removed from the shoe. The signals are sent to the microprocessor, and are used to determine when the dealer removes the cards.

Sensor 602 is the shoe empty sensor. This sensor generates a signal when no cards are
15   present in the shoe. The sensor generates a signal that is sent to the microprocessor. This signal is interpreted by the microprocessor as an instruction to deliver another group of cards to the shoe. This sensor is a back-up sensor, because the shoe is normally not empty. The sensor is used primarily to verify that the shoe is empty when the machine is initially loaded with cards.

Unloader trigger sensor 604 senses the amount of cards in the shoe, and generates a
20   signal when a predetermined minimum number of cards are present in the shoe. The signal is sent to the microprocessor, and the microprocessor interprets the signal as an instruction to

unload and deliver another group of cards into the shoe. In one example, the trigger sensor 604 activates a random number generator. The random number generator randomly selects a number between zero and three. The selected number corresponds to the number of additional cards to be dealt out of the shoe prior to unloading the next group of cards. If the randomly selected

5 number is zero, the unloader immediately unloads the next group of cards.

Unloader extended switch 606 generates a signal that is indicative of the position of the unloader. When the unloader is in the extended position, unloader extended switch 606 generates a signal that is received by the microprocessor. The microprocessor interprets the signal as instructions to halt forward movement of the unloader, and reverse movement.

10 Staging switch 608 senses the position of the unloader. The sensor 608 is positioned at a point along the card way 206. As a group of cards reaches the sensor, the sensor sends a signal to the microprocessor to stop forward movement of the unloader. A group of cards is therefore staged in the card way 206. The microprocessor also receives signals from sensor 600 so that the staged group of cards is released while the dealer is removing cards from the shoe. This assures

15 that the cards in the shoe, if pushed backwards initially, are traveling toward or resting against the exit of the shoe during unloading. In another example of the invention, the staging switch 608 unloads only when a signal from switch 600 is interrupted.

Rack Emptying Sensor 610 indicates when a rack has been unloaded. The sensor is functional only when the shoe cover is open. This sensor functions during a process of emptying

20 cards from the machine. The microprocessor interprets the signal as instructions to initiate the emptying or unloading of a rack. When the signal is interrupted, the microprocessor instructs the rack to align another compartment with the unloader.

Shoe Cover Switch 612 indicates the presence of the shoe cover. When the signal is interrupted, the microprocessor halts further shuffling. When the signal is reestablished, normal

25 shuffling functions resume upon reactivating the machine.

Door Present Switch 614 senses the presence of the door covering the opening to the racks. When the signal is interrupted, the microprocessor halts further shuffling. When the signal is reestablished, normal shuffling functions resume upon reactivating the machine.

Card Out Sensor 616 indicates when a card is passing into the rack from the speed up

30 rollers 516. The microprocessor must receive the signal in order to continue to randomly select a

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compartment or shelf and instruct the elevator motor 638 to move the elevator to the next randomly selected position. If the signal is interrupted, the microprocessor initiates a jam recovery routine. To recover from a card jam, the elevator is moved up and down a short distance. This motion almost always results in a trailing edge of the jammed card making

5   contact with the speed up rollers 516. The speed up rollers then deliver the card into the compartment. If the recovery is unsuccessful, the signal will remain interrupted, operations will hault. An error signal will be generated and displayed, and instructions for manually unjamming the machine will preferably be displayed. The function of the Card Out Sensor 161 is also critical to the card counting and verification procedure described above, as the signal produces a

10   count of cards in each shelf in the rack.

Card In Sensor 618 is located on an infeed end of the speed-up rollers 516 and is used both to monitor normal operation and to provide information to the microprocessor useful in recovering from a card feed jam. During normal operation, the microprocessor interprets the generation of the signal from sensor 618, the interruption of that signal, the generation and

15   interruption of card out sensor 616, in sequence as a condition of counting that card. If a card would travel in the reverse direction, that card would not be counted. During the jam recovery process, the interruption of the signal from sensor 618 tells the microprocessor that a jam occurring in the speed up rollers 516 has been cleared.

Card Separator Empty Sensor 620 monitors the progression of the cards as the cards

20   leave the brake roller assembly 511. Although there is another card present sensor 626 as will be described below in the input shoe 10, sensor 620 senses the presence of the card before the signal generated by sensor 626 is interrupted. Because the spacing between sensors 620, 626 is less than a card length, the information sent to the microprocessor from both sensors provides an indication of normal card movement.

25   Switch 622 is the main power switch. Upon activating the switch, a signal is sent to the microprocessor to activate the shuffling process. In one embodiment of the invention, upon delivering power to the shuffler, a test circuit first tests the voltage and phase of the power supply. A power adapter (not shown) is provided, and the available power is converted to a D.C. power supply for use by the shuffler.

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Light 624 is an alarm light. The microprocessor activates the alarm light whenever a fault condition exists. For example, if the cover that closes off the mixing stack or the shoe cover is not in place, the alarm light 624 would be illuminated. If the card verification procedure is activated, and an incorrect number of cards is counted, this would also cause light 624 to

5   illuminate. Other faults such as misdeals, card feed jams, card insertion jams, card delivery jams, and the like are all possible triggering events for the activation of alarm light 624.

Feeder Empty Sensor 626 is an optical sensor located on a lower surface of the card receiving well 60. This sensor sends a signal to the microprocessor. The microprocessor interprets the signal as an indication that cards are present, and that the feed system is to be

10   activated. When the signal is interrupted, indicating that no cards are in the well 60, the feed roller 502 stops delivering cards. In one embodiment, the lower driven roller 514 of brake roller assembly 511 runs continuously, while in the embodiment shown in Figure 19, the lower roller runs only when feed roller 502 runs. Similarly, speed up rollers 516 can run continuously or only when the feed roller 502 and brake roller 514 is being driven. In one example, the

15   operation of rollers 514 and 502 is intermittent, while the operation of speed up rollers 516 is continuous.

Referring back to Figure 20, Enter Key 628 and Scroll Key 630 are both operator input keys. The Enter Key 628 is used to access a menu, and to scroll down to a particular entry. The Scroll Key 630 permits the selection of a field to modify, and Enter Key 628 can be used to input

20   or modify the data. Examples of data to be selected and or manipulated includes: the type of game being played, the number of decks in the game, the number of cards in the deck, the number of promotional cards, the total number of cards in the machine, the table number, the pit number, and any other data necessary to accomplish card verification. Enter Key 628 provides a means of selecting from a menu of preprogrammed options, such as the type of game to be

25   played (such as blackjack, baccarat, pontoon, etc.), the number of cards in the deck, the number of promotional cards, the number of decks, etc. The menu could also include other information of interest to the house such as the date, the shift, the name of the dealer, etc. This information can be tracked and stored by the microprocessor in associated memory, and included in management reports, or in other communications to the house.

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A number of motors are used to drive the various rollers in the feed assembly (shown in Figure 19). Feed roller 502 is driven by motor 504, via continuous resilient belt members 504B and 504C. Brake roller driven roller 514 is also driven by motor 504 via resilient continuous member 504B. In another embodiment, rollers 502 and 514 are driven by different motors.

5   Speed up roller assembly 516 is driven by motor 507, via resilient belt member 507B. Each of the motors is typically a stepper motor. An example of a typical stepper motor used for this application is available from Superior Electric of Bristol, Connecticut by ordering part number M041-47103.

Motor 636 drives the unloader 190 via continuous resilient member 636B. The resilient

10   member 636B turns pulley or pinion gear 637, causing lateral motion of unloader 190. Teeth of pinion gear 637 mesh with openings 194 in the unloader (see Figure 8).

Rack motor 638 causes the rack assembly to translate along a linear path. This path is preferably substantially vertical. However, the rack could be positioned horizontally or at an angle with respect to the horizontal. For example, it might be desirable to position the rack so

15   that it travels along a horizontal path to reduce the overall height of the device. The shaft of motor 638 includes a pulley that contacts resilient member 82 (Figure 12). Resilient member is fixedly mounted to the rack assembly.

Unloader home switch 640 provides a signal to the microprocessor indicating that the unloader 190 is in the home position. The microprocessor uses this information to halt the

20   rearward movement of the unloader 190 and allow the unloader to cease motion.

Rack home switch 642 provides a signal to the microprocessor that the rack is in the lowermost or "home" position. The "home" position in a preferred embodiment causes the feed assembly to come into approximate vertical alignment with a top shelf or opening of the rack. In another embodiment, the "home" position is not the lowermost position of the rack.

25   Gate motor 644 drives the opening and closing of the gate. Gate down switch 646 provides a signal to the microprocessor indicating that the gate is in its lowermost position. Gate Up Switch 648 provides a signal that the gate is in its uppermost position. This information is used by the microprocessor to determine whether the shuffling process should proceed, or should be stopped. The microprocessor also controls the gate via motor 644 so that the gate is opened

30   prior to unloading a group of cards.

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In a preferred device of the present invention, the number of cards in the rack assembly is monitored at all times while the shuffler is in the dealing mode. The microporcessor monitors the cards fed into and out of the rack assembly, and provides a visual warning that the number or amount of cards in the rack assembly is below a critical (predetermined, preset) number or level.

5 When such a card count warning is issued, the microprocessor stops delivering cards to the shoe. When the cards are fed back into the machine and the number of cards in the rack assembly rises to an acceptable (preset or predetermined) level, the microprocessor resumes unloading cards into the shoe. The number of cards is dependent upon the game being dealt and the number of players present or allowed. For example, in a multi-deck blackjack game using 208 cards (four

10 decks), the minimuj number of ards in the rack is approximately 178. At this point, a signal is sent to the visual display. When the number of cards drops to 158 (the preset number), the microprocessor will stop delivery of cards to the shoe. Limiting the number of cards outside the rack assembly maintains the integrity of the random shuffling process.Although a description of preferred embodiments has been presented, various changes including those mentioned above

15 could be made without deviating from the spirit of the present invention. It is desired, therefore, that reference be made to the appended claims rather than to the foregoing description to indicate the scope of the invention.